

# User's Guide

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## Use of This Chapter

RESRAD for Windows is built with many features to facilitate use and understanding of the software. This chapter extends that design with further documentation. The manual is also found on the RESRAD web site with hypertext links set for easier navigation and searching. Sections for this support are:

- 1) Installation: Various installation procedures for distribution media.
- 2) Navigation: Moving around the interface to accomplish tasks. How to save input and output results.
- 3) Input Windows: A closer look at parameters on the input windows.
- 4) Output Windows: How to find results in the textual and graphical output.
- 5) Extensions & Help: How to use sensitivity and uncertainty analysis. Finding out what help is available.

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# Installation

## Requirements

- Windows 3.1, 3.11 or Windows 95 Operating System
- 486 or higher processor
- 4 MB of RAM
- 15 MB of disk space

## From Disks

- Insert Disk 1 into appropriate floppy drive
- Run SETUP.EXE program from disk drive (for example, A:SETUP)
  - With Windows95, this can be done through the Start/Run sequence or through the Explorer
  - With Windows3.x, this can be done through the File Manager or Windows Program manager.
- Enter information requested by the standard installation program
- After installation, a new RESRAD icon will be placed in the RESRAD group. Double-clicking this icon will start RESRAD.

## Uninstalling

- Click on Uninstall RESRAD icon
- Files will be removed from system

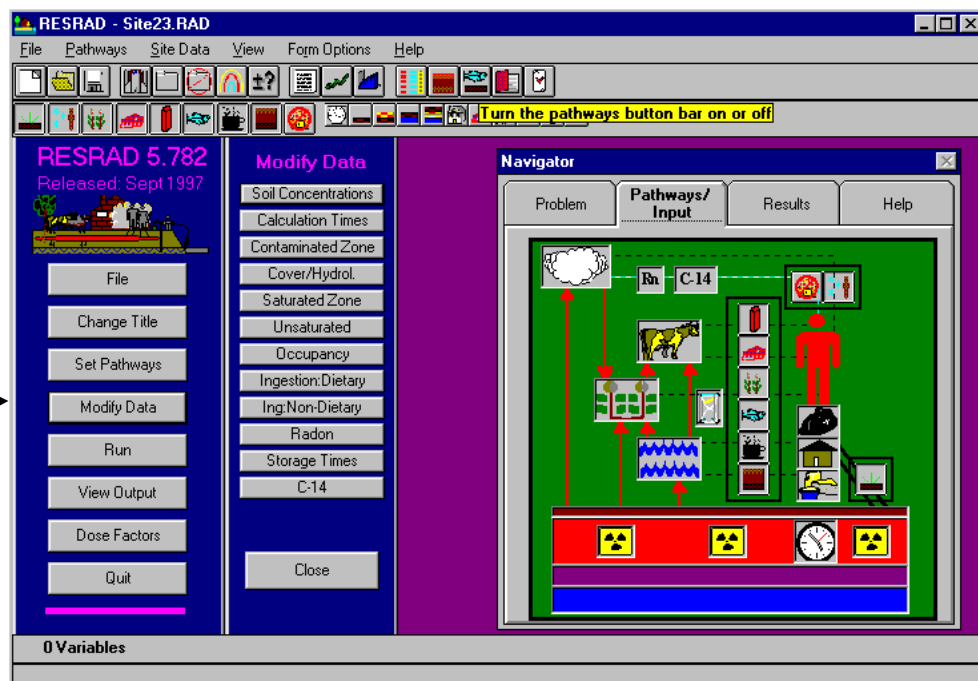
## Troubleshooting

- \_\_\_\_\_: DOS mode should have at least the following in CONFIG.SYS: FILES=30; BUFFER=16; SHELL=C:\DOS\COMMAND /P/E:512
- Calculations with no feedback: In Windows3.x the Foreground Exclusive option should not be on. This can be found in the "386 Enhanced" property setting.
- Output report format: If MSLineDraw Font is not available as a font, install the font using the file Linedraw.ttf in your font directory.
- Viewing Output: RESRAD needs a printer driver installed. It is not necessary to attach a printer.
- Very slow computations compared with others: SMRTDRV.EXE in CONFIG.SYS for proper speed performance

# Navigation

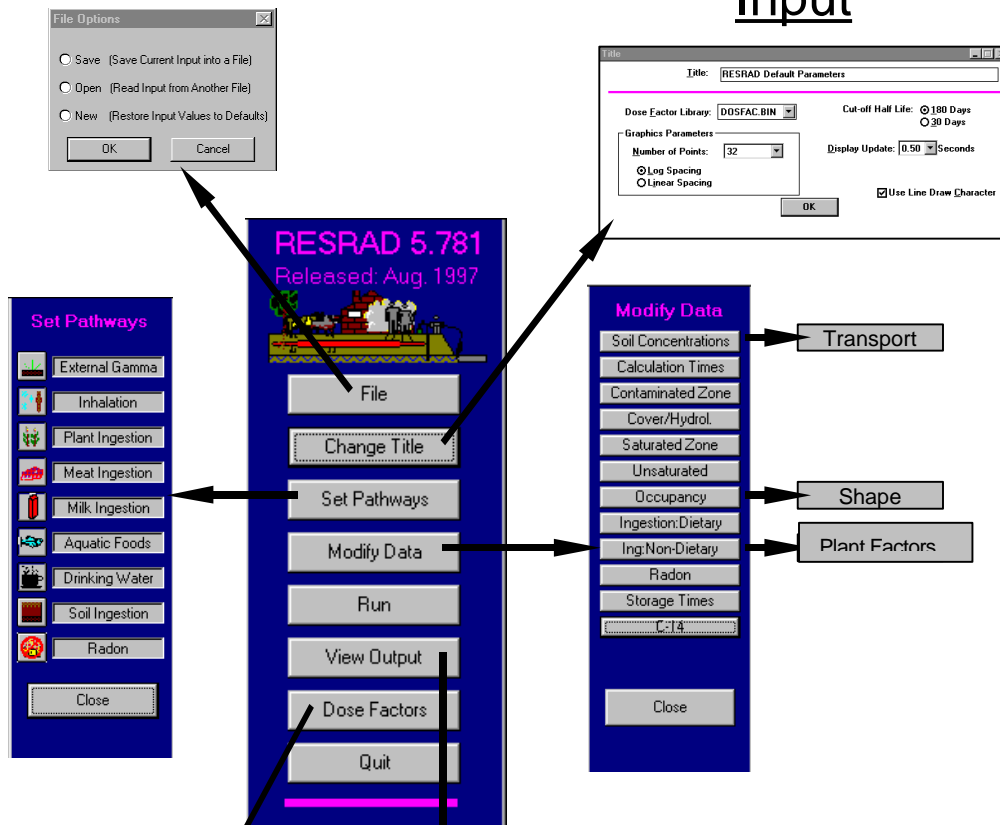
There are three independent ways to access information through the RESRAD interface:

- **RESRAD-DOS Emulator:** a set of window menus with textual command buttons similar to the RESRAD for DOS interface to ease transition for the user familiar with the DOS version.
- **Windows Navigator:** A tabbed window that allows access to the information through more graphical means.
- **Menu and Tool Bar :** standard windows tools to open and close files, access input and results windows, and definitions of short-cuts keys for advanced users.

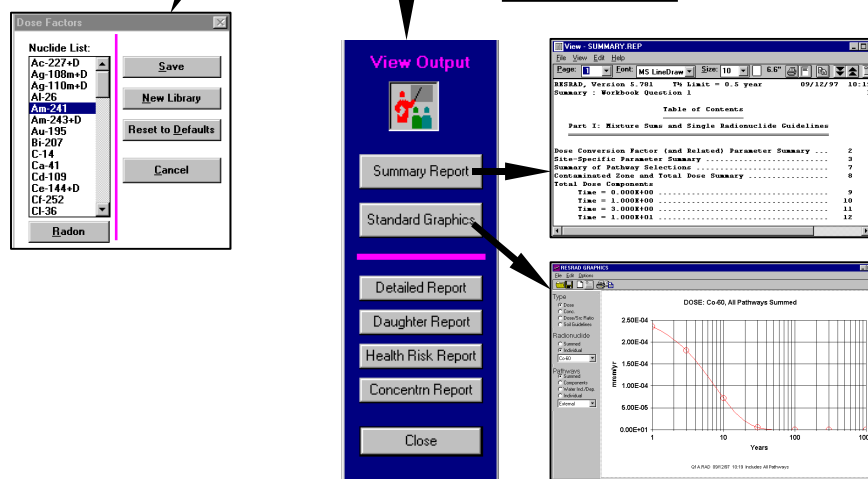


# RESRAD-DOS Emulator

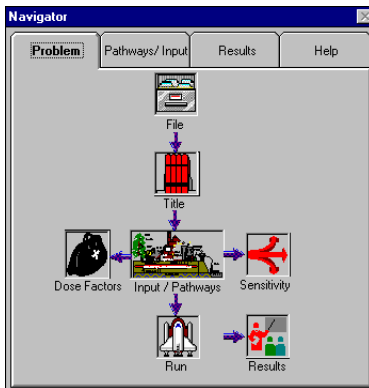
## Input



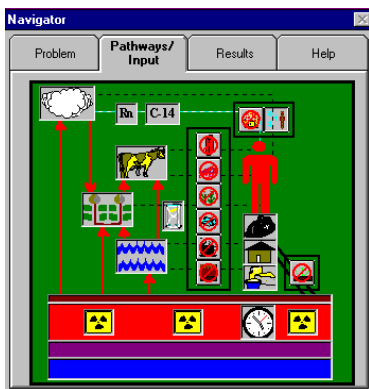
## Results



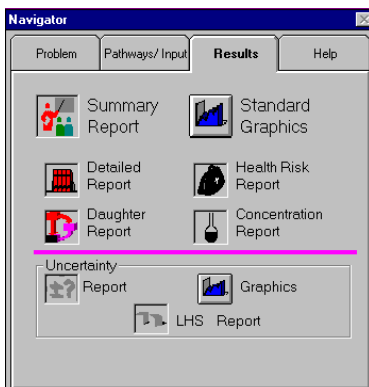
## Windows Navigator



**PROBLEM:** Guide through setting up a case in RESRAD. Each button will bring up windows to continue with the process.



**Pathways/Input:** View and set pathways activation. All pathway buttons are in the black boxes. Inhalation pathways are above the person. Ingestion pathways are to the left. The single external pathway is at the lower right. Access input windows by clicking on icons. Prompts appear to display what the icon means if the View/ButtonPrompts option was selected from the main menu.

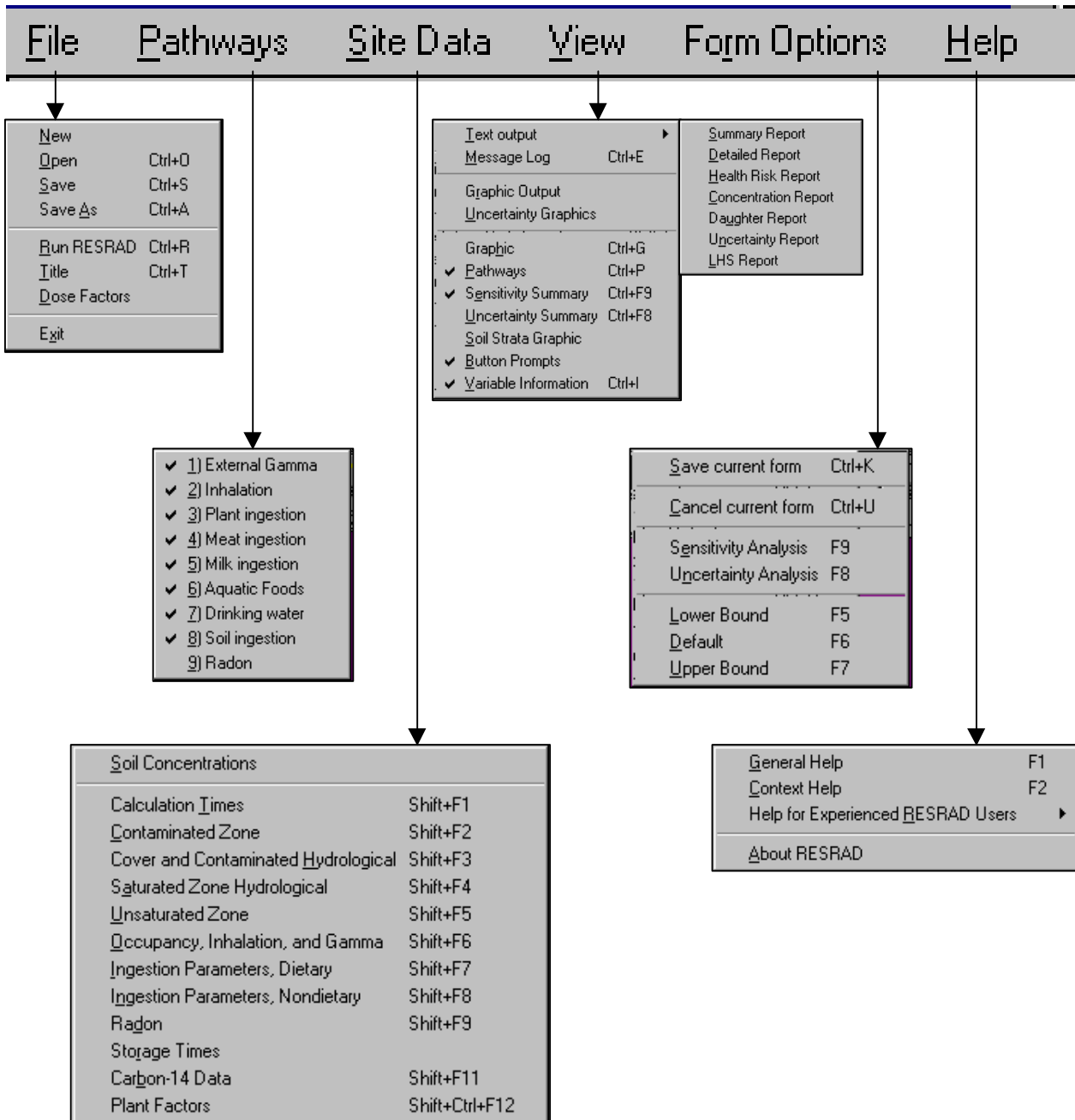


**Results:** The top two buttons give access to the main results in report and graphical forms. The next two rows are the supplementary reports. If uncertainty analysis was run there are 3 more buttons below the purple line to access the 2 reports and set of graphics.



**Help:** Access all help features including parameter descriptions, selected slides from the workshop, the data collection handbook, and (if connected to the internet) the RESRAD Web site.

















## Menu




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## Toolbars

### Primary ToolBar

Files				Input				Results			Display Feedback				
															
Reset all parameters to the defaults	Open an existing data file	Save data to the current data file	Generate Reports	Save Changes to the current form	Cancel changes to the current form	Display or close sensitivity analysis window	Display or close uncertainty analysis window	View the latest Summary Report	View Standard Graphics	View Uncertainty Graphics	Display or close pathway graphic	Display or close soil strata graph	Display or close pathway toolb	Display or close sensitivity summe	Display or close uncertainty summe

### Pathway Toolbar

Set Active Pathways										Windows Modified/Pertinent									
																			

### Sensitivity Info Bar

2 Variables		COVER0 */ 2	VCV */ 2
Variable Name:	VCV	Default:	.001
		Range:	0 to 5

### Variable Info Bar



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## Input Windows

There are 19 input windows to enter the parameters concerning site data, assumptions, problem identification, and calculation specifications. The following pages describe each screen in detail. Most input is through numerical entry into boxes, although some selections are through standard windows list boxes, check boxes, and option boxes. Some common features for all input windows:

**Saving Information to Memory:** There are two levels of saving information in RESRAD. The first level is to temporarily save the information to memory. This is done with any of the following commands.

- Function Keys: Press F10 key to save, ESC key to cancel
- On Window: Press Save Button to save, Cancel Button to cancel
- Menu: Select FormOptions/Form Save from main menu to save, Form Options/Form Cancel to cancel
- ToolBar: Press the Folder Button to save; the Canceled Folder Button to cancel

**Saving Information to File:** The second level is to save the settings to a disk file. This is done with any of the following commands.

- Window: Press File button in DOS Emulator or Navigator.
- Menu: Select File/Save or Save As
- ToolBar: Press the Disk Button to save to a file
- Run: the file must be saved to disk before a run. Follow prompts to save in desired place.

**Numerical Entries:** (Some entry boxes may be grayed out because they are not applicable to the current case)

Defaults: To set the selected parameter back to its default either select FormOptions/Default from the main menu or press the F6 function key.

Bounds: To set the selected parameter to its upper (or lower) bound either select the FormOptions/UpperBound(LowerBound) from the main menu or press the F7 (F5) function key.

Help : Context specific help will be shown anytime the F2 function key is pressed. For further sources of help please refer to the Extensions & Help section of this chapter.

# Title

The screenshot shows a Windows-style dialog box titled "Title". Inside the dialog, there is a text field labeled "Title:" containing the text "RESRAD Default Parameters". Below this, there are several settings: "Dose Factor Library:" with a dropdown menu showing "DOSFAC.BIN"; "Cut-off Half Life:" with two radio buttons, "180 Days" (selected) and "30 Days"; "Graphics Parameters:" which is a group box containing "Number of Points:" with a dropdown menu showing "32", and two radio buttons, "Log Spacing" (selected) and "Linear Spacing"; "Display Update:" with a dropdown menu showing "0.50" and the word "Seconds"; and a checkbox labeled "Use Line Draw Character" which is checked. An "OK" button is located at the bottom center of the dialog.

**Title:** text to describe the problem being modeled. This text will appear at the top of each report page.

**Dose Factor Library:** set of factors to use. Libraries of dose conversion factors can be set up using the Dose Factors window. Attention should be made to whether the library is for 30 or 180 day cutoff half-life.

## **Graphic Parameters:**

**Number of points:** number of times besides the user-specified evaluation times which will be used to generate smoother data plots. A higher number means higher graphic resolution but also longer execution times.

**Spacing:** how the extra graphic points will be distributed between 0 and the maximum user-specified evaluation time.

**Cut-off Half Life:** indicates assumption about secular equilibrium for principle and associated radionuclides. See section 3.1 for further details.

**Display Update:** time for the updating of the feedback message during execution. For most systems the default is fine.

**Use Line Draw Characters:** It is recommended that the MS Line Draw Font be used for the reports. This font produces well formatted tables and good lines. If another font is desired it is suggested that this box be unchecked to substitute minus signs for the lines.

# Initial Concentrations of Principal Radionuclides

Source

Nuclide Concentration: 50 pCi/g

Co-60	100
Pb-210	0
Ra-226	0
Th-230	0
U-234	0
U-238	50

Add Nuclide

Delete Nuclide

Transport

OK

Nuclide List:

- Th-230\*
- Th-232
- Tl-204
- U-232
- U-233
- U-234\*
- U-235
- U-236
- U-238\*
- Zn-65

**Principle Radionuclide:** a radionuclide with a half-life longer than the cut-off half-life (one-half year by default). See section 3.1 for discussion on associated radionuclides.

To Add a Radionuclide either click the radionuclide name in the right scroll box and click the “Add Nuclide” button, or just double click the radionuclide name. The radionuclide will show up in the left scroll box with a concentration specified in the top center input box. All potential decay products will be added to the left scroll box with a default concentration of 0 if they are not already present .

To Delete a Radionuclide click on the radionuclide name on the left scroll box and then click the “Delete Nuclide” button. All potential decay products which arise only from the deleted radionuclide and have zero initial concentration will be automatically deleted also.

To View or Edit Transport Parameters click on the radionuclide name on the left scroll box and then click the “Transport” button.

**Nuclide Concentrations:** Radionuclide concentration averaged over an appropriate depth and area. See the section 3.3 and the RESRAD Data Collection handbook for more details.

To change an existing radionuclides concentration: Click on the radionuclide in the left box, enter the concentration.

To change the default concentration when adding new radionuclides: Click on the right box. Now enter the concentration in the top center box. To add radionuclides with this concentration see above description.

Note: The single radionuclides soil guidelines do not depend on the soil concentration; however, the mixture sum does depend on the soil concentration. Thus, calculated mixture sum values are valid only if the concentrations are known.

## Radionuclide Transport Factors

Transport Factors	
Radionuclide: Co-60	
Distribution Coefficients:	
Contaminated Zone:	1000
Unsaturated Zone 1:	1000
Saturated Zone:	1000
Unsaturated Zones:	1
Options:	
Water Concentration	
Time since waste placement:	0
Groundwater Concentration:	0
Solubility Limit:	1
Leach Rate:	0
Use Plant/Soil ratio	<input type="checkbox"/>
Save	Cancel

**Distribution Coefficients:** the ratio of the mass of solute adsorbed or precipitated on the soil (per unit of dry mass) to the solute concentration in the liquid. Defaults are provided for each radionuclide; however, site-specific values can vary over many orders of magnitude depending on the chemical form, soil type, pH, redox potential, and the presence of other ions.

**Options:** Besides directly entering values for the distribution coefficients there are 4 options for non-direct estimation. Some estimates might give unrealistic (negative) values. The first valid value from the ordered list below is used in the calculations.

Use of water concentrations: a distribution coefficient will be estimated based on consistency of the soil concentration, water concentration and time since placement. This is attempted when both the time since placement and the water concentration are non-zero. For nuclides in a chain, the parent radionuclides distribution coefficients should be found before their progeny.

Use of solubility limit: see Appendix J. Attempted when solubility limit is non-zero.

Use of leach rate: the distribution coefficient will be set for all zones to the value from equation E.3. Attempted when non-zero leach rate is entered.

Use of plant/soil ratios: derived distribution coefficients. Attempted when check box is checked.

Direct input of distribution coefficient: if none of the above options were applied or gave a valid value, then the entered value will be used.

# Calculation Parameters

**Calculation Parameters**

**Basic Radiation Dose Limit:**  mrem/yr

**Times for Calculation (years):**

1 10 100 1000 10000 100000

1)	1
2)	3
3)	10
4)	30
5)	100
6)	300
7)	1000

**Basic Radiation Dose Limit:** annual radiation dose limit used to derive all site-specific soil guidelines.

**Times for Calculation:** times following the radiological survey at which results will be generated. Graphical output will supply intermediate values between the first and last user-specified times. A time horizon of 1,000 years is commonly used; however, calculations can be carried out to longer periods to identify potential problems from delayed contributions from the groundwater or other pathways. Results are always calculated for year 0.

## To add a time:

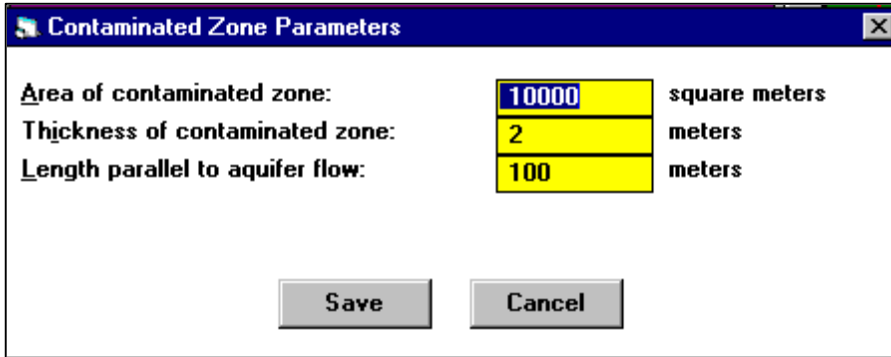
- Press the Add Button: a new clock icon and time box will appear. Set the time following the change time procedure, or
- Click the right mouse button while in the frame containing the clock icons.

To remove a time: Click on the appropriate time box or click on the clock icon and then press the Remove button

## To change a time:

- Click on the appropriate time box and enter new value, or
- Click on the appropriate clock icon and drag to desired time location.

## Contaminated Zone Parameters



Area of contaminated zone:	10000	square meters
Thickness of contaminated zone:	2	meters
Length parallel to aquifer flow:	100	meters

Save Cancel

**Area of contaminated zone:** compact area which contains the location of all soil samples with radionuclide concentrations that are clearly (2 standard deviations) above background.

**Length parallel to aquifer flow:** distance between two parallel lines perpendicular to the direction of the aquifer flow, one at the upgradient edge of the contaminated zone and the other at the downgradient edge.

## Cover and Contaminated Zone Hydrological Data

Cover and Contaminated Zone Hydrological Data		
Cover depth:	0	meters
Density of cover material:	1.5	grams/cm <sup>3</sup>
Cover erosion rate:	.001	meters/year
<hr/>		
Density of contaminated zone:	1.5	grams/cm <sup>3</sup>
Contaminated zone erosion rate:	.001	meters/year
Contaminated zone total porosity:	.4	
Contaminated zone effective porosity:	.2	
Contaminated zone hydraulic conductivity:	10	meters/year
Contaminated zone b parameter:	5.3	
<hr/>		
Humidity in air:	8	grams/m <sup>3</sup>
Evapotranspiration coefficient:	.5	
Wind Speed	2	meters/s
Precipitation:	1	meters/year
Irrigation:	.2	meters/year
Irrigation mode:	<input checked="" type="radio"/> Overhead <input type="radio"/> Ditch	
Runoff coefficient:	.2	
Watershed area for nearby stream or pond:	1000000	square meters
Accuracy for water/soil computations:	.001	
<div>Save</div> <div>Cancel</div>		

**Cover Depth:** distance from the ground surface to the location of the uppermost soil sample with radionuclide concentrations that are clearly above background.

**Erosion Rates:** rate at which soil is removed by erosion. They can be estimated by means of the universal soil loss equation described in Appendix A. The contaminated zone erosion rate is only significant if and when the cover depth becomes zero.

**Humidity in Air:** used only for tritium model as discussed in Appendix L, along with a map of average U.S. humidity values.

**Wind Speed:** annual average wind speed used to calculate the area factor for inhalation and foliar deposition (Appendix B and D). Also used for dispersion calculations for the radon pathway (Appendix C) and in the tritium and carbon-14 models (Appendix L).

**All other parameters:** discussed in Appendix E, including typical values for various soil materials.

## Saturated Zone Hydrological Data

Saturated Zone Hydrological Data		
Density of saturated zone:	1.5	grams/cm <sup>3</sup>
Saturated zone total porosity:	.4	
Saturated zone effective porosity:	.2	meters/year
Saturated zone hydraulic conductivity:	100	
Saturated zone hydraulic gradient:	.02	
Saturated zone b parameter:	5.3	
Water table drop rate:	.001	meters/year
Well pump intake depth:	10	meters below water table
Model for Water Transport Parameters:	<input checked="" type="radio"/> Nondispersion <input type="radio"/> Mass-Balance	
Well pumping rate:	250	cubic meters/year
<div>Save</div> <div>Cancel</div>		

**Nuclide-Independent Parameters:** six hydrological strata characteristics are discussed further in Appendix E. The nuclide-dependent Kd values are found in the "Transport" window of each radionuclide. The b parameter is used only if the water table drop rate is greater than 0.

**Mass-Balance Option:** all radionuclides released from the contaminated zone are withdrawn through the well. For more details of this model see Appendix E.

**Nondispersion Option:** the concentration of radionuclide in the well water considers a more complicated geometry for calculating the dilution term. For more details of this model see Appendix E.



## Uncontaminated Unsaturated Zone Parameters

Thickness meters	Density grams/cm**3	Total Porosity	Effective Porosity	Hydraulic Conductivity meters/year	b Parameter
4	1.5	.4	.2	10	5.3

**Unsaturated Zones:** portion of the uncontaminated zone that lies below the contaminated zone and above the groundwater table.

**Number of Unsaturated Zones:** the code has provisions for up to five different horizontal strata.

**Nuclide Independent Parameters:** six hydrological strata characteristics are discussed further in Appendix E. Each stratum is also characterized by the nuclide-dependent Kd values found in the "Transport" window of each radionuclide.

## Occupancy, Inhalation, and External Gamma Data

**Occupancy, Inhalation, and External Gamma Data**

Inhalation rate:	8400	m <sup>3</sup> /year
Mass loading for inhalation:	.0001	grams/m <sup>3</sup>
Exposure duration:	30	years
Inhalation Shielding factor:	.4	
External Gamma Shielding factor:	.7	
Indoor Time fraction:	.5	
Outdoor Time fraction:	.25	
Shape of the Contaminated Zone:	<input checked="" type="radio"/> Circular <input type="radio"/> Non-Circular	

Save Cancel Shape

**Exposure Duration:** Length of time the receptor is exposed. This parameter is used only for risk calculations, not for dose calculations. If the exposure duration is greater than 1 year, the risk will be estimated using a 5 point integral over the exposure duration. This, however, increases the computation time.

**Indoor Time Fraction:** fraction of the year the receptor spends in a building situated on top of the contaminated zone.

**Outdoor Time Fraction:** fraction of the year the receptor spends outside on top of the contaminated zone.

**Shape of the Contaminated Zone:** By default the receptor is assumed to be placed in the middle of a circularly shaped contaminated zone for purposes of the external gamma exposure. If the receptor is not in the middle, or if the contaminated area is not circular, the “Non-Circular” option can be chosen. Then the receptor location and contamination shape can be set by clicking on the “Shape” button.

## External Radiation Area Factors

Area:  m\*\*2

Radius:	Fraction:
1 50	1
2 70.71068	.2732395
3 0	0
4 0	0
5 0	0
6 0	0
7 0	0
8 0	0
9 0	0
10 0	0
11 0	0
12 0	0

Instructions

*Use the left mouse button to change the receptor location.*

*Press the Calculate button to complete the calculations.*

Current X:	<input type="text" value="47"/>	Receptor Location:	<input type="text" value="47"/>
Current Y:	<input type="text" value="44"/>		<input type="text" value="43"/>
Starting X:	<input type="text" value="65"/>	Line Length:	<input type="text" value="74.686"/> meters
Starting Y:	<input type="text" value="91"/>	Scale:	<input type="text" value="100"/> meters

**Set contaminated area shape and receptor location:** follow these steps

Set Scale: Enter dimension of graphic box in the central bottom part of the window.

Drawing contaminated area: follow instruction in the lower right. Indicate vertices with the left mouse button, the current line length and points are shown in the lower left box. Click the right mouse button to specify the last vertex.

Specify the Receptor location: click the left mouse button to set and change the receptor location.

Calculate the area fractions: press the Calculate button to complete the calculations of the contaminated fraction of the 12 annular regions.

Save the setup: Press the Save Form button on the tool-bar or use the menu selections FormOptions/ Save Current Form.

## Ingestion Pathway, Dietary Data

Ingestion Pathway, Dietary Data		
Fruit, vegetable, and grain consumption:	160	kilograms/year
Leafy vegetable consumption:	14	kilograms/year
Milk consumption:	92	liters/year
Meat and poultry consumption:	63	kilograms/year
Fish consumption:	5.4	kilograms/year
Other seafood consumption:	.9	kilograms/year
Soil ingestion:	36.5	grams/year
Drinking water intake:	510	liters/year
<hr/>		
Contaminated fractions	Drinking water:	1
	Household water:	1
	Livestock water:	1
	Irrigation water:	1
	Aquatic food:	.5
	Plant food:	-1
	Meat:	-1
	Milk:	-1
Save		Cancel

**Top half parameters:** national averages which are usually site independent. Adjustments for regional differences in diet may sometimes be appropriate.

### Contaminated fractions:

First 4: fraction of water used that originates from the contaminated site. No mass balance is maintained between these parameters and the well pumping rate.

Plant, meat and milk: The -1 default value indicates that the area factor method discussed in Section D.2.1.2 will be used.

## Ingestion Pathway, Nondietary Data

Ingestion Pathway, Nondietary Data		
Livestock fodder intake for meat:	68	kilograms/day
Livestock fodder intake for milk:	55	kilograms/day
Livestock water intake for meat:	50	liters/day
Livestock water intake for milk:	160	liters/day
Livestock intake of soil:	.5	kilograms/day
<hr/>		
Mass loading for foliar deposition:	.0001	grams/m**3
Depth of soil mixing layer:	.15	meters
Depth of roots:	.9	meters
<hr/>		
Groundwater Fractional Usage (balance from surface water)		
Drinking water:	1	<div>Plant Factors</div> <div>Save Cancel</div>
Household water:	1	
Livestock water:	1	
Irrigation water:	1	

**Top half parameters:** national averages which are usually site independent. Adjustments for regional differences in farming practices may sometimes be appropriate.

**Groundwater Fractional Usage parameters:** indicates fraction of contaminated water from groundwater (well or spring). The remainder of the contaminated water is from surface water (pond or river). Not to be confused with the Contaminated Fractions discussed earlier. As an example, selecting a drinking water Contaminated fraction of 0.6 and a Groundwater Fractional Usage of 0.5 would result in 40% of drinking water coming from an uncontaminated source, 30% from an on-site well or spring, and 30% from an on-site pond or river.

## Plant Factors

	Non-Leafy	Leafy	Fodder	
Wet weight crop yield	.7	1.5	1.1	kg/m <sup>2</sup>
Length of growing season	.17	.25	.08	years
Translocation factor	.1	1	1	
Weathering removal constant	20			1/year
Wet foliar interception fraction	.25	.25	.25	
Dry foliar interception fraction	.25	.25	.25	
Save		Cancel		

**Plant Factors:** additional parameters discussed in Appendix D which are usually site-independent, but may depend of regional farming practices.

## Radon Data

Radon Data		
Cover total porosity:	.4	
Cover volumetric water content:	.05	
Cover radon diffusion coefficient:	.000002	m**2/s
Bldg foundation thickness:	.15	meters
Bldg foundation density:	2.4	g/cm**3
Bldg foundation total porosity:	.1	
Bldg foundation volumetric water content:	.03	
Bldg foundation radon diffusion coefficient:	.0000003	m**2/s
Contaminated radon diffusion coefficient:	.000002	m**2/s
Radon vertical dimension of mixing:	2	meters
Building air exchange rate:	.5	1/hr
Building room height:	2.5	meters
Building indoor area factor:	0	
Foundation depth below ground surface:	-1	meters
Rn-222 emanation coefficient:	.25	
Rn-220 emanation coefficient:	.15	
<div>Save</div> <div>Cancel</div>		

**Radon pathway:** discussed in detail in Appendix C. These parameters are only used when a radon parent for either Rn-222 (U-238, U-234, Th-230, Ra-226) or Rn-220 (Th-232, Ra-228, Th-228) are present as contaminants. The Wind Speed found on the Cover and Contaminated Zone Hydrological Data window is also used for the outdoor radon dose component calculation.

**Building indoor area factor:** fraction of the floor area built on the contaminated area. Values greater than 1.0 indicate a contribution from walls penetrating the contaminated zone. The default value 0 indicates the time dependent area factor is derived from an assumed floor area of 100 m<sup>2</sup> and the amount of wall extending into the contaminated zone.

**Foundation depth below ground surface:** depth from surface to basement slab bottom. The default -1 indicates that the slab will be placed directly on top of the contaminated zone.

## Storage Times Before Use Data

Storage Times Before Use Data		
Fruits, non-leafy vegetables, and grain:	14	days
Leafy vegetables:	1	days
Milk:	1	days
Meat:	20	days
Fish:	7	days
Crustacea and mollusks:	7	days
Well water:	1	days
Surface water:	1	days
Livestock fodder:	45	days
<div>Save Cancel</div>		

**Storage Times:** Time during which foodstuffs are stored allowing for radionuclide decay before consumption. These usually have very minor effects on results. See Appendix D for more details.

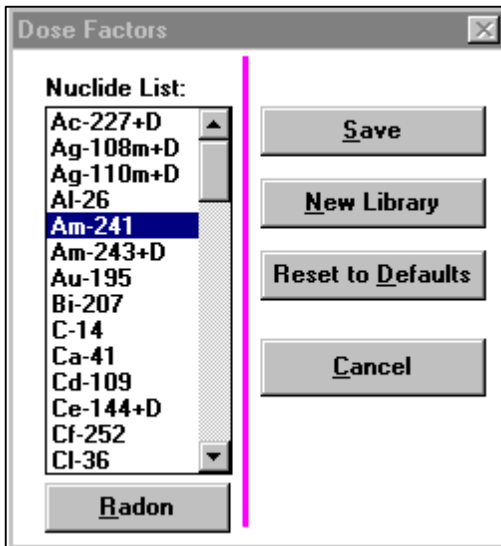


## Carbon-14 Data

Carbon-14 Data		
C-12 concentration in local water:	.00002	g/cm**3
C-12 concentration in contaminated soil:	.03	g/g
Fraction of vegetation carbon absorbed from soil:	.02	
Fraction of vegetation carbon absorbed from air:	.98	
Thick of evasion layer of C-14 in soil:	.3	meters
C-14 evasion flux rate from soil:	.0000007	1/sec
C-12 evasion flux rate from soil:	1E-10	1/sec
Grain fraction in livestock feed (balance is hay/fodder)		
Beef cattle:	.8	
Milk cow:	.2	
<div>Save</div> <div>Cancel</div>		

**C-14 parameters:** See discussion in Appendix L.

## Dose Factors List



**Dose Conversion Factor Library:** a complete set (i.e. not just the radionuclides in the current problem) of radionuclide dose conversion factors, risk slope factors and element-dependent transfer factors.

Save: save the current settings to the file specified on the title screen. The default File DOSFAC.BIN cannot be overwritten.

New Library: specify a file name to save the current settings. This file name will automatically be placed in the Title window as the file to use for the current run.

Reset to Defaults: resets all parameters to defaults in DOSFAC.BIN.

### Setting Factors:

Radon: click Radon button to enter factors.

Other Radionuclides: Double click nuclide name to view windows for editing factors.

## Dose Factors

Co-60

Ingestion Dose Conversion Factors  
(mrem/pCi)

GI Tract Fraction:

☒ 3.0E-1
 ☐ 5.0E-2

.0000269

.0000102

Inhalation Dose Conversion Factors  
(mrem/pCi)

Lung Clearance Class:

☐ W
 ☒ Y

.0000331

.000219

Transfer Factors  
(Element Dependent):

Plant:	0.08	
Meat:	0.02	(pCi/kg)/(pCi/d)
Milk:	0.002	(pCi/L)/(pCi/d)
Fish:	300	(pCi/kg)/(pCi/L)
Crustacea:	200	(pCi/kg)/(pCi/L)

Slope Factors:

External:	.0000098	(Risk/yr)/(pCi/g)
Inhalation:	6.9E-11	(Risk/pCi)
Ingestion:	1.9E-11	(Risk/pCi)

Ok

Cancel

Help

±?

**Ingestion Dose Conversion Factors:** all of EPA's FGR-12 factors for various GI tract fractions are shown. The maximum factor is selected as the default.

**Inhalation Dose Conversion Factors:** all of EPA's FGR-12 factors for various lung clearance classes are shown. The maximum factor is selected as the default.

**Slope Factors:** from EPA HEAST report.

**External Dose Conversion Factors:** from EPA's FGR-11. These are not available for editing. They are reported in the detailed dose report in the external radiation section.

**Transfer Factors:** see detailed discussion in Appendix D.

## Risk & Dose Factors for Radon

Radon Progeny Slope Factors			
Parent	Progeny	Slope Factor (Risk/pCi)	
Ra-226	Rn-222:	1.8E-12	<input type="button" value="Ok"/> <input type="button" value="Help"/>
	Po-218:	3.7E-12	
	Pb-214:	6.2E-12	
	Bi-214:	1.5E-11	
Th-228	Rn-220:	1.9E-13	
	Po-216:	3.0E-15	
	Pb-212:	3.9E-11	
	Bi-212:	3.7E-11	

---

Radon Dose Conversion Factors			
	Indoor	Outdoor	
Rn-222	7.6E+02	5.7E+02	mrem/ WLM
Rn-220:	1.5E+02	2.5E+02	mrem/ WLM

**Slope Factors:** from EPA HEAST Report

**Dose Conversion Factors:** see discussion in Appendix C for use.

---

# Results

RESRAD produces 5 textual reports and many graphical options for standard problems. Each report's first page is a table of contents. Sensitivity analysis results can be viewed as an option in the standard graphics. Uncertainty analysis results are produced in a report and uncertainty graphics. The content of the textual reports are reviewed. Then use of the report viewer and graphics windows is reviewed.

## Standard Textual Reports

### Summary Report

- Input : Dose conversion factors
  - Site specific input
- Doses: User specified times summary
  - Peak dose summary
  - Dose components for various times
- Guideline Info:
  - Dose/source ratios
  - Soil guidelines

### Detailed Report

- Source factors
- Ground pathway
- Inhalation pathway
- Radon pathway
  - Fluxes
  - Working levels
- Water pathways
  - Transport times
  - Rise time
  - Dilution factors
- Food pathways

Environmental transport factors  
Dose/source ratios  
Concentration ratios  
Soil ingestion

### **Concentration Report**

Concentrations at user-specified times in media:  
Soils (contaminated and surface)  
Air  
Water (well and surface)  
Foodstuffs( milk, meat, vegetables, fish)  
Fodder

### **Risk Report**

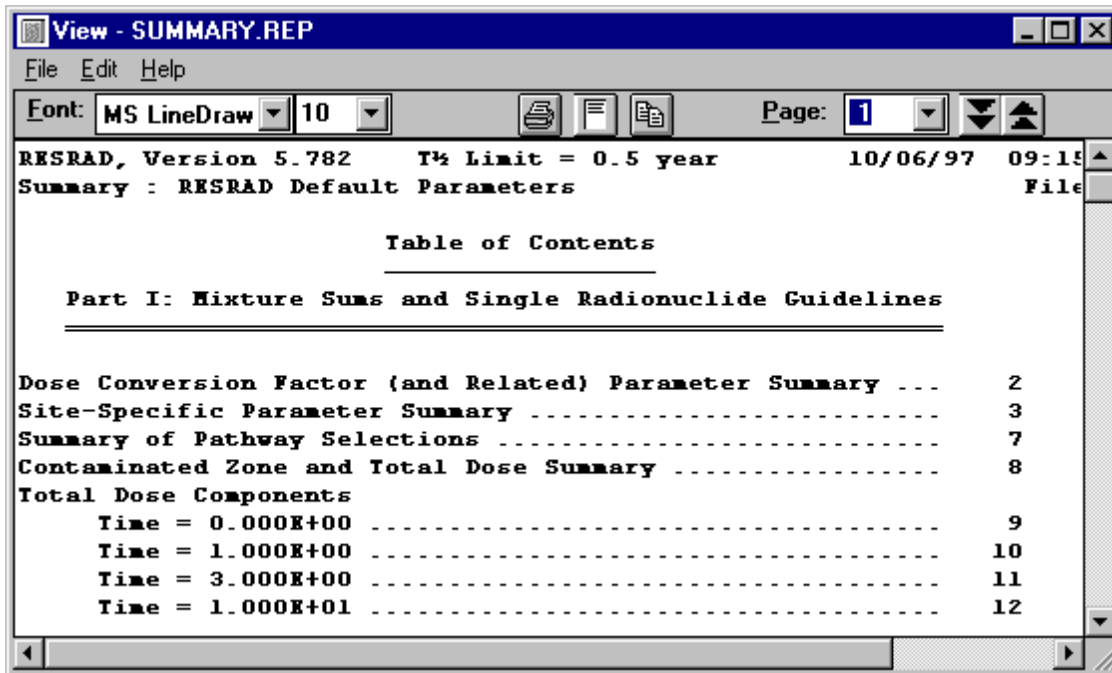
Cancer risk slope factors  
Excess cancer risks & intake quantities

### **Progeny (Daughter) Report**

Dose contributions by daughter products

### **Uncertainty Report**

## Report Viewer



The Report Viewer is launched automatically at the end of each run, displaying the Summary Report. However, the Report Viewer may be accessed at any time from the Menu, Toolbar, DOS Emulator, or Navigator.

### Getting to the Report Viewer from:

Menu: Select View/Text Reports/Summary or any other report.

Toolbar: press the report page icon (Summary Report only)

DOS Emulator: press the View Results button and then the Summary Report or any other button

Navigator: press the Summary Report or other report button when in the Results Tab Window.

### Moving Around:

Pages: to go to another page choose one of the following methods:

- Enter page number in page text box and hit return
- Pull down the page list and click on desired page
- Advance a page by pressing the "Page Down" key, click on the double down arrows.

- Go back a page by pressing the “Page Up” key or by clicking the double up arrows.

Within a Page: Use scroll bars to position text.

Between Reports: Select the File/Open Another File from the Main Menu to view another report or close the viewer and go back to the main window to select a different file.

## **Saving Files:**

- **Note:** Everytime a calculation is run, the previous reports and graphics files are overwritten. The results can be saved under different names allowing their retrieval later.
- Saving All Files: Select File/Save All under the Viewer menu. This will save all textual reports to files. If the input filename is xxxx.rad the reports will be saved as xxxx.yyy where the extension yyy is “sum” for the summary report, “det” for the detailed report, etc.
- Saving the open report: Select File/Save under the Viewer menu. This will prompt for a name to save the currently displayed report.

## **Copying Selections:**

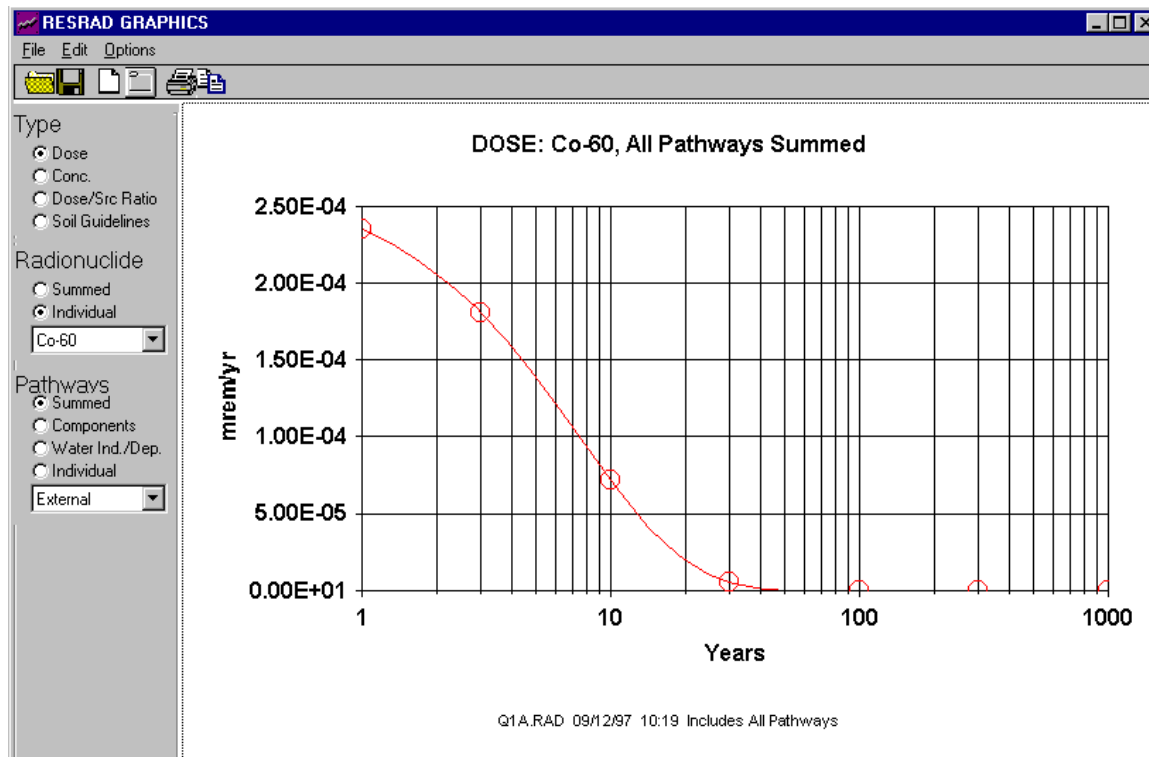
- Copy highlighted section: Select Edit/Copy under the Viewer menu. The selected text will be placed on the windows clipboard and can be placed into any document such as a spreadsheet or word processor.
- Copy the current page: Select Edit/Select All followed by Edit/Copy. Or press the icon that looks like two pages.
- Copy to Excel: If MS Excel is on the computer, a table can be highlighted and automatically placed into an Excel spreadsheet. This feature does not currently work with MS Excel 97.

## **Printing**

- Setting up the Printer: RESRAD uses the standard windows printer. The setup for the printer can be accessed through the File/Printer/Setup menu option. Options include printer selection, paper size selection, and orientation selection.
- Setting up the report for printing: Press the single page icon button to automatically select the best font size to fit the report to a single page width.
- Printing: Select the File/Print menu option or press the printer icon button. A dialogue box will appear allowing printing of the whole report, sets of pages, or the current highlighted text.



## Graph Viewer



### Getting to:

DOS Emulator: Click View Output to bring up the output form. Click on Standard Graphics.

Windows Navigator: Click the Results tab then click the Standard Graphics icon.

Menu: Click View on the menu and select Graphic Output

Toolbar: Click the icon with the button prompt, view RESRAD standard graphics.

### Setting Up:

Data to Plot: Data for radionuclides and pathways can be manipulated to produce a variety of plots. The following parameters can be specified to select a plot.

- Type

Dose: Select Dose to view a graphical representation of the dosage contributions of selected radionuclides taken over a user specified number of years (mrem/yr).

Conc.: Displays a plot of the concentration of individual radionuclides in various media (pCi/g).

Dose/Src Ratio: Displays a graphical representation of an individual radionuclide's ratio of dose contribution (millirems/yr) over concentration ((mrem/yr) / (pCi/g)).

Soil Guidelines: Select Soil Guidelines to view a graph

- Radionuclide

Summed: Plots the sum of all user selected radionuclides.

Individual: Plots a single user selected radionuclide.

- Pathways

Summed: Plots all pathways summed.

Components: Plots all pathways as individual components.

Water Ind/Dep: Plots summed water dependent and summed water independent pathways only.

Individual: Plots a single selected pathway.

- Sensitivity

Base Case: Indicates not to plot sensitivity results. This is the default setting.

Parameter: Plots sensitivity results on a user selected parameter.

## Feedback

Printing: Clicking Select from the menu presents you with two options, Print and Print Setup. Select Print to print the current plot displayed with preset print options. Select Print Setup to change these printer options.

Title: The plot's title is divided into three parts. For example, the title in Figure 1 is, DOSE: Co-60, All Pathways Summed. The first part before the colon represents the current Type option selected, in this case DOSE. The second part after the colon represents the current Radionuclide option selected, in this case the individual radionuclides Co-60 is selected. The last part of the title after the comma represents the current Pathway selected, in this case all pathways are summed.

Sending to Excel:

---

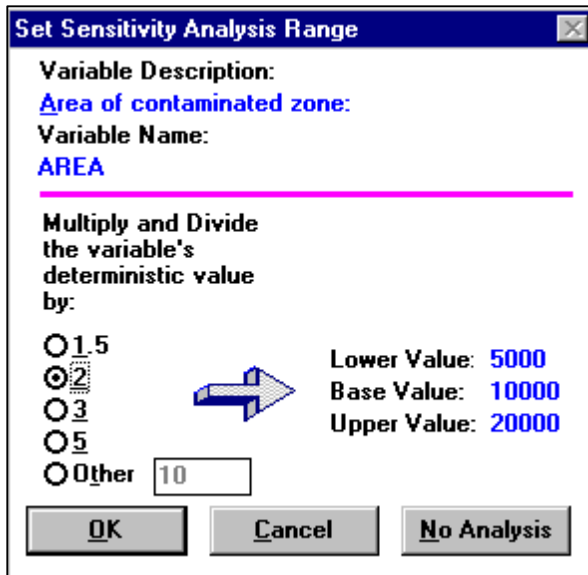
## Extensions

RESRAD for Windows is built with many features to extend normal calculations to increase understanding of the problem and identification of the important input parameters.

- Sensitivity Analysis
- Uncertainty Analysis
- Help
  - Soil Graphic Feedback
  - General Help
  - Parameter Descriptions
  - Graphical Help
  - Data Collection handbook
  - Connection to Web Site
  - Message Log

---

## Sensitivity Analysis



The dialog box titled "Set Sensitivity Analysis Range" contains the following elements:

- Variable Description:** "Area of contaminated zone:"
- Variable Name:** "AREA"
- Multiply and Divide the variable's deterministic value by:**
  - ☐ 1.5
  - ☒ 2
  - ☐ 3
  - ☐ 5
  - ☐ Other:
- Lower Value:** 5000
- Base Value:** 10000
- Upper Value:** 20000
- Buttons:** OK, Cancel, No Analysis

### Showing:

Menu: with focus on parameter of interest, click on View/Set Sensitivity

Toolbar: with focus on the parameter of interest click on the Set Sensitivity Button

Input Window: click on the parameter of interest, then press the F9 key.

Status Bar: if sensitivity has already been set for a parameter, the sensitivity summary bar (shown if View/Sensitivity Summary is set) will include a button for each sensitivity analysis. The title of the button includes the variables name and an indicator of the factor to multiply and divide by (\*). Click on any button to review, set or remove sensitivity analysis on the parameter.

### Setting:

Factor: choose one of the options for the multiplication and division factor. The resultant values for the two sensitivity runs will be shown at the right along with the base value. If you choose "Other", enter any value greater than 1. If a selection cause a parameter value to exceed its bounds, the sensitivity factor will be reset to the maximum allowable.

Adding: Choose OK to add sensitivity analysis for the parameter.

Deleting: Choose No Analysis to cancel or remove sensitivity analysis

**Output:** Sensitivity analysis results are only shown in the graphics, not in any textual report. After running a case with sensitivity analysis the left hand column of options should have a “Sensitivity Analysis” frame at the bottom.

## Uncertainty Analysis

**Uncertainty Analysis Summary**

Random Seed: 1000      Correlation:

Number of Observations: 30

Number of Repetitions: 1

NORMAL

Delete      Correlate      Ok

Variable Description	Variable	Distribution	Mean	Std.Dev.
Density of saturated zone	DENSAQ	NORMAL	1.5	.15
Saturated zone total porosity	TPSZ	NORMAL	.4	.04

**Uncertainty Analysis:** used to evaluate the combined effect of distributions on a set of input parameters. The details of the uncertainty analysis are discussed in Appendix O.

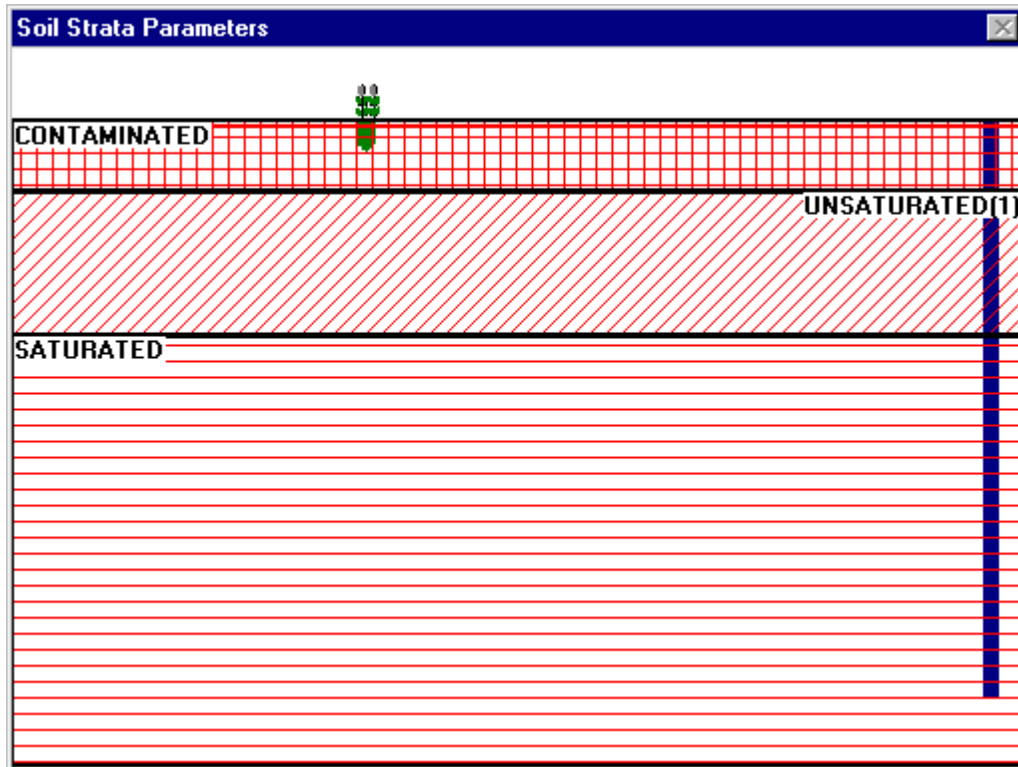
### Showing:

- Menu: click View/Uncertainty Analysis
- Toolbar: click Uncertainty Analysis button on secondary toolbar
- Input Window: press the F8 function key while focus is on the input parameter to consider
- **General parameters:**
  - Random Seed: Integer which sets the function which randomly generates numbers to determine selection of evaluation points.
  - Number of Observations partitions in the function for Latin Hypercube Sampling. The number of total runs for the problem is equal to the number of observations multiplied by the number of repetitions. For standard Monte Carlo analysis set the Number of Observations to 1.
  - Number of Repetitions number of times the partitioned function will be sampled. The number of total runs for the problem is equal to the number of observations multiplied by the number of repetitions. For standard Monte Carlo analysis set the Number of Observations to 1.

- **Variable parameters:**
  - Distribution: probability distribution of variable. Possible distributions: Normal, Log-Normal, Uniform, Log-Uniform, Triangular. To change the distribution type, click on the box under Distribution for the variable of interest. Then either click on the yellow background figure corresponding to the distribution or select the name from the pull-down list to the left of the figures.
  - Distribution Characterization: Each distribution needs 2 or 3 numerical parameters to characterize the distribution, depending on the type of distribution.
- **Correlation:**

---

## Soil Graphic



### Showing:

- Select the View/SoilGraphics option from the menu bar, or
- Click the "Soil Graphic" Button on the Secondary Toolbar (To get this set the View/Toolbar option)

### Information Feedback:

- The scale is set by the 1 m high corn stalk
- Number of layers considered
- Depth of layers considered
- Depth of the mixing layer (Solid red line)
- Depth of plant roots
- Well depth

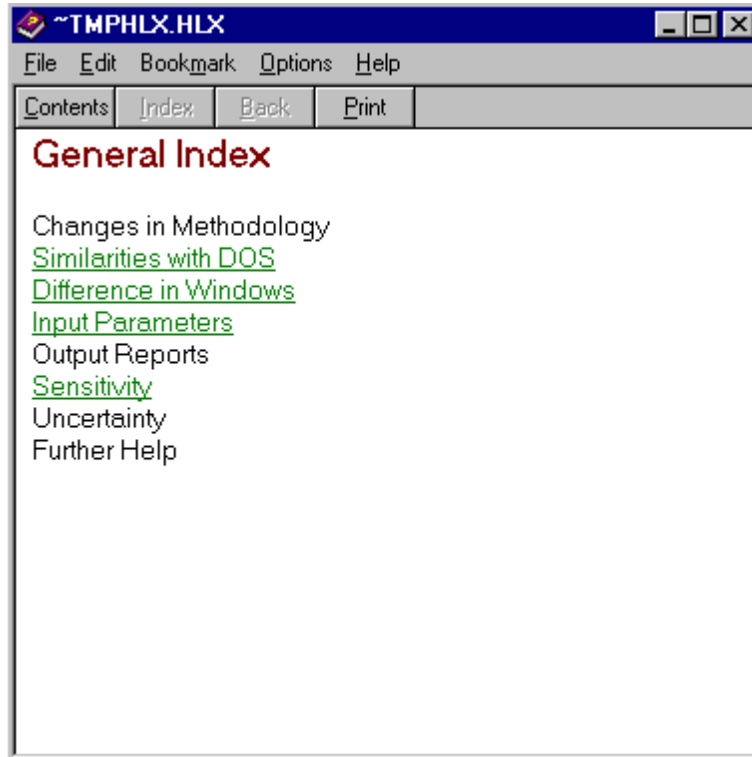
### Navigation



Clicking a soil layer will open it's data input window

---

## General Help



### Getting To:

- Press the F1 key
- If the Help window is open click contents to get to the first page.
- Choose Help/Contents from the Main menu.

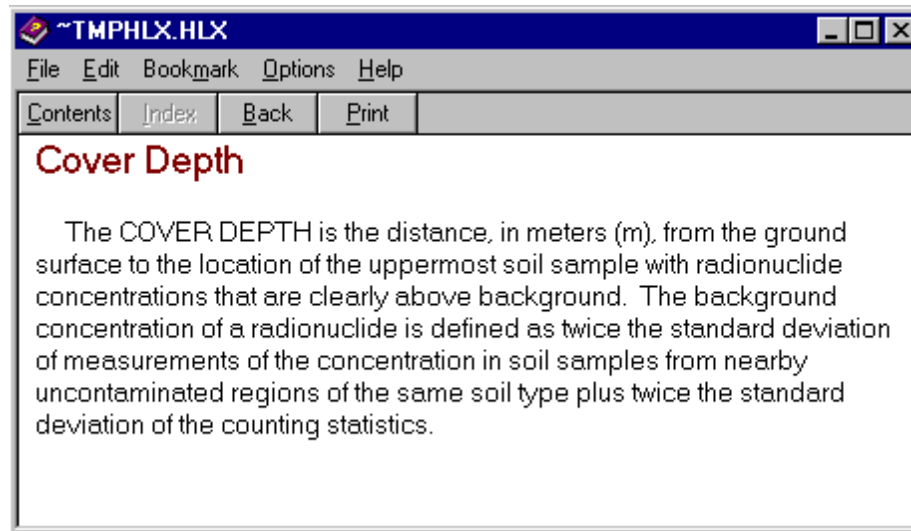
### Contents:

- Simple description of the input parameter. For more information please refer to the RESRAD Data Collection Handbook.
- Differences with other versions
- Interface operational features
- Output help
- Contacts for further help



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## Parameter Description



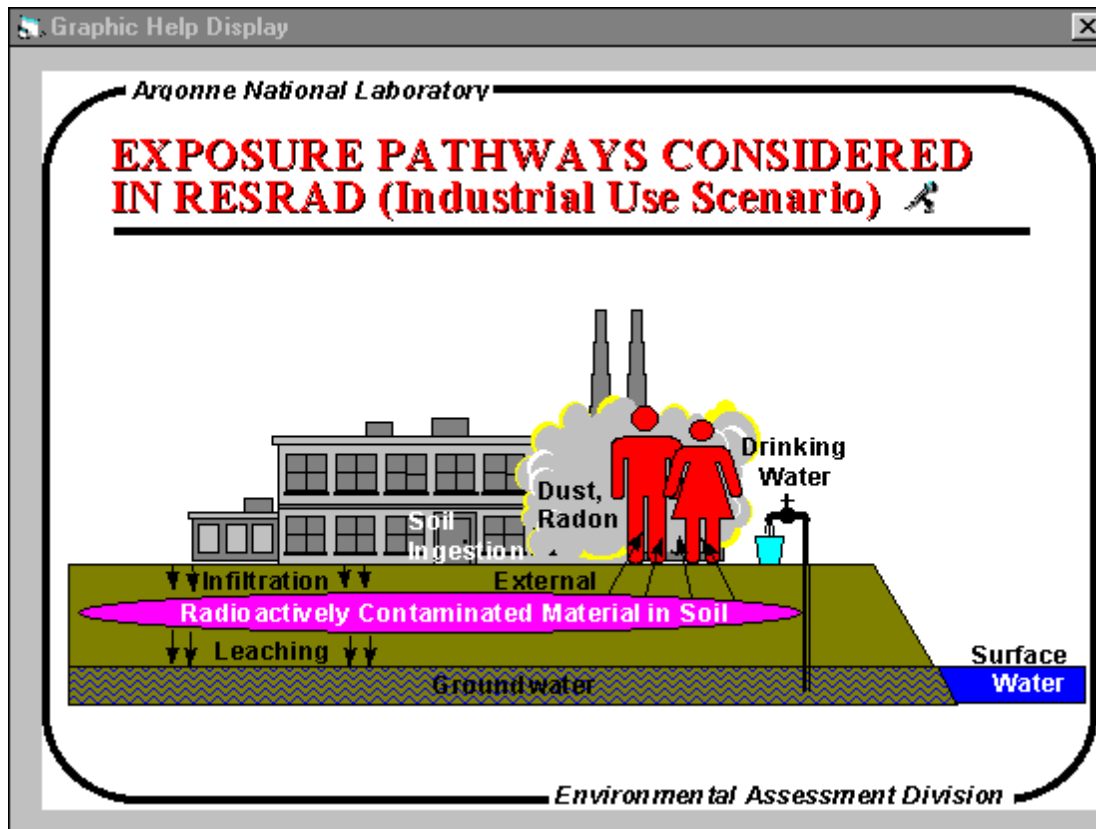
### **Getting To:**

- Choose the input box of the input parameter of interest, then press the F2 key
- Click the parameter description in the Textual Help list found on the Navigator's Help tab window.
- If the Help window is open click contents and follow table of contents to find the parameter of interest.

### **Contents:**

- Simple description of the parameter. For more information please refer to the RESRAD Data Collection Handbook.

## Graphical Help

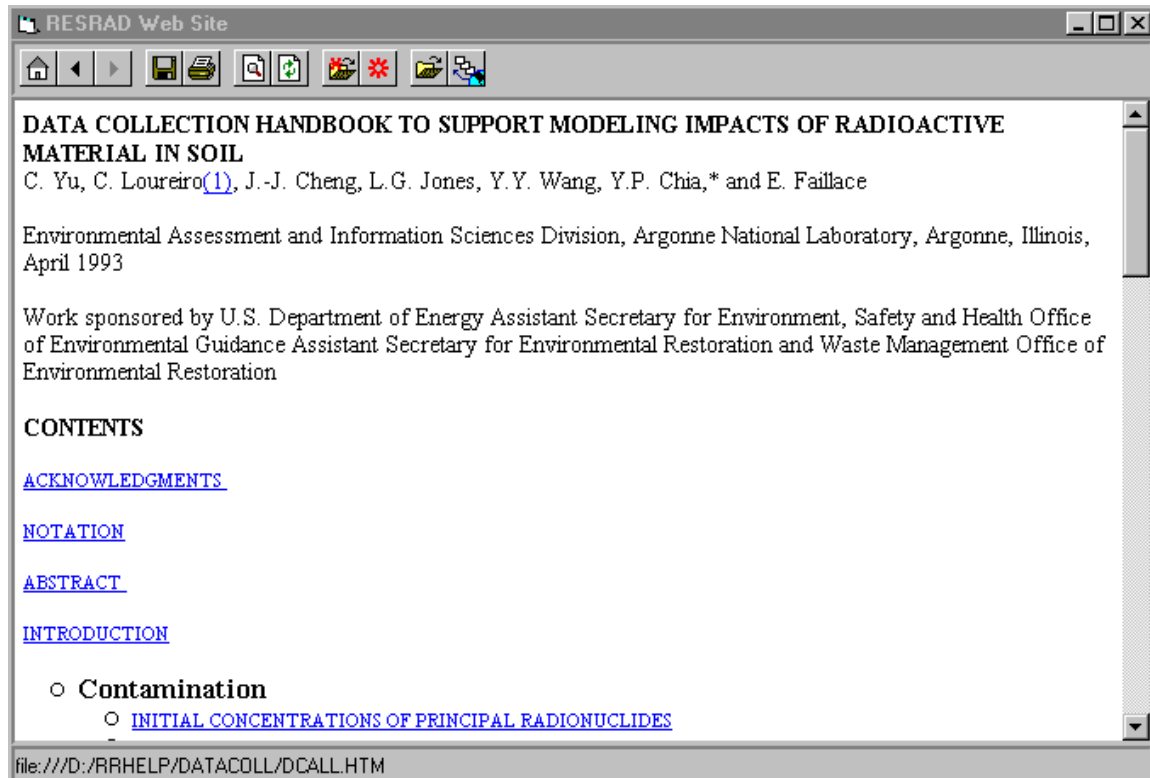


**Getting To:** Click the Graphical Help topic of interest in the Navigator's Help Tab Window. To close click the standard close window control.

**Contents:** Various slides from the RESRAD Workshop

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## Data Collection Handbook

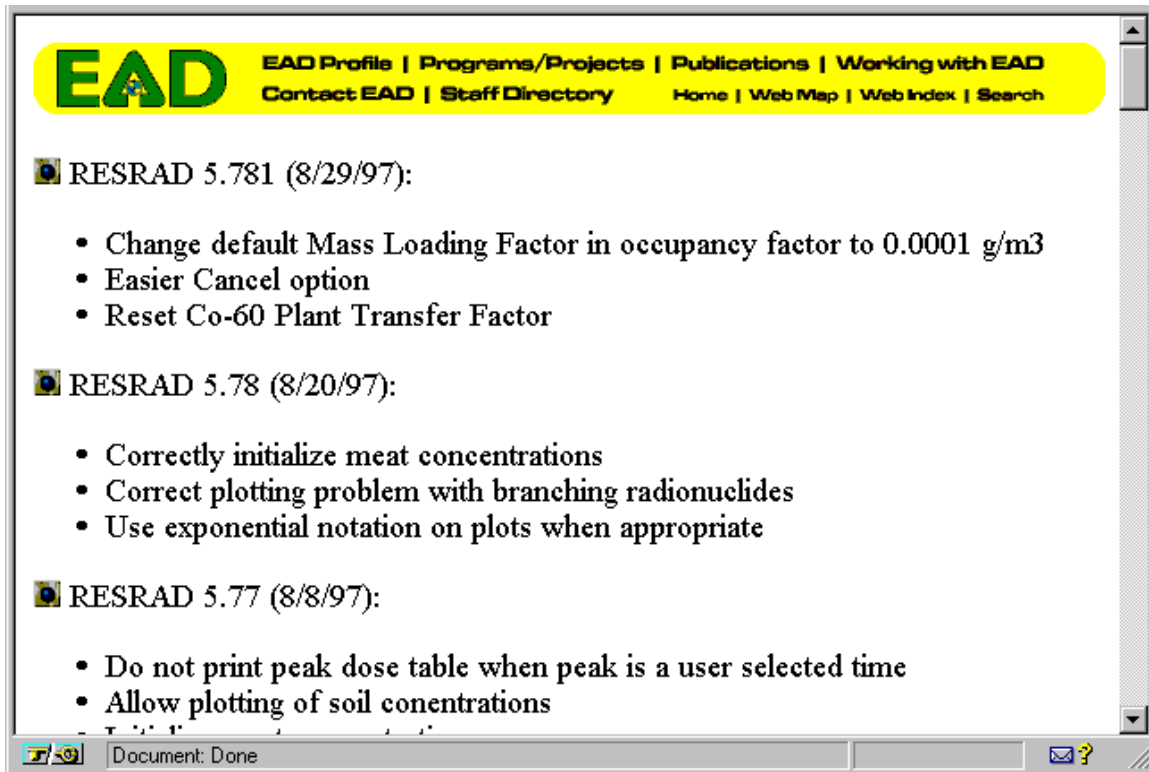


**Getting To:** The RESRAD Data Collection handbook can be viewed by clicking the Data Collection Handbook button in the Navigator's Help Tab window. It is also on the RESRAD website.

**Contents:** The Table of Contents linked to all sections and variable discussions.

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## Web Site



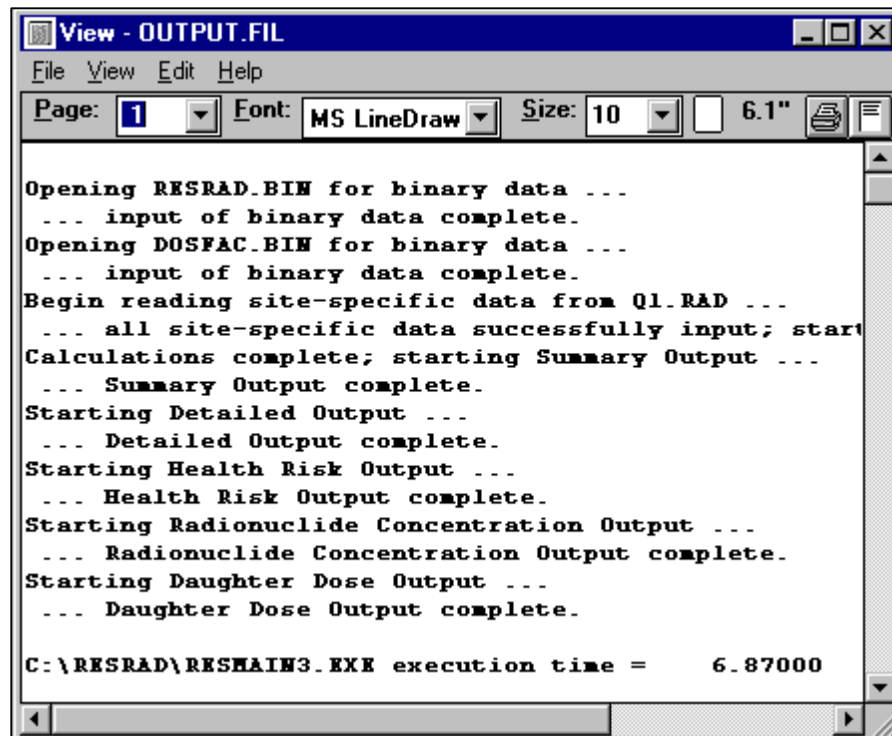
**Getting To:** The RESRAD website is at [www.ead.anl.gov/resrad.html](http://www.ead.anl.gov/resrad.html) This site can be reached through your normal browser or through the browser included in RESRAD by clicking the RESRAD WebSite button in the Navigator Help Tab .

### **Contents:**

- Descriptions of the RESRAD Family of Codes
- Table of current versions and release status
- Upcoming training workshops and pictures from previous workshops
- Listing of version releases and dates along with a short description of the included modifications
- Email contact
- Data Collection Handbook and selected other documents

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## Message Log



```
View - OUTPUT.FIL
File View Edit Help
Page: 1 Font: MS LineDraw Size: 10 6.1"
Opening RESRAD.BIN for binary data ...
... input of binary data complete.
Opening DOSFAC.BIN for binary data ...
... input of binary data complete.
Begin reading site-specific data from Q1.RAD ...
... all site-specific data successfully input; start
Calculations complete; starting Summary Output ...
... Summary Output complete.
Starting Detailed Output ...
... Detailed Output complete.
Starting Health Risk Output ...
... Health Risk Output complete.
Starting Radionuclide Concentration Output ...
... Radionuclide Concentration Output complete.
Starting Daughter Dose Output ...
... Daughter Dose Output complete.

C:\RESRAD\RESMAIN3.EXE execution time = 6.87000
```

**Getting To:** From the main menu, choose View/Message Log.

**Interpretation:** This file contains calculation execution information which normally can be disregarded. If there were some problems with the calculation, this file should show some type of diagnostic which can be reported. The execution time is also displayed at the end of this file.

**Reporting Problems:** The email address for communicating problems and questions is [resrad@anl.gov](mailto:resrad@anl.gov).